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(Reaffirmed 2005)

Indian Standard

ENVIRONMENTAL TESTS FOR AIRCRAFT EQUIPMENT

PART XIV MECHANICAL VIBRATION

Aircraft and Space Vehicles Sectional Committee, EDC 74; Environmental and Operating Condition for Aircraft Equipment, EDC 74 : 4 [Doc : EDC 74 (3457)]

1. Scope — This standard specifies mechanical vibration tests used to verify the minimum requirements needed to demonstrate that, under the influence of vibratory stresses likely to be encountered in an aircraft, aircraft equipment has a satisfactory performance within the specified limits of use and is free from obvious defects in design and construction.

1.1 In the case of equipment which is expected to have a high level of reliability and/or high structural integrity, the client and/or the approving authority may require additional endurance testing. Such tests shall be defined by the client.

1.2 As the duration of the test is short relative to the service life of the equipment, reliability and fatigue aspects are not taken into account in this standard. It relates only to rectilinear vibrations applied successively along the three reference axes of the equipment.

1.3 By classifying equipment in three categories representing the major types of aircraft — helicopters, turbine-engined aircraft, and piston — engined aircraft — it is possible to select frequency ranges and levels which are sufficiently varied.

1.4 Two classes of severity levels are proposed : standard levels and severe levels.

1.5 In general, the test proper (endurance phase) is performed in accordance with one of the following methods, as required by the client.

- Sinusoidal vibrations with logarithmic frequency sweep;
- Sinusoidal resonance frequency vibrations;
- Wide band random vibrations; or
- Narrow band random vibrations with logarithmic frequency sweep.

1.6 In the specific cases of equipment intended for one type of aircraft, and where vibration recordings are available, recorded vibration tests may be carried out.

1.7 In special cases where one or more specific frequencies exist within the vibratory spectrum of a particular aircraft, sinusoidal vibration tests at these fixed frequencies may be specified by the client.

2. Procedures to be Specified by the Client

2.1 *Mandatory*

- Definition of the equipment;
- Orientation of the equipment (*see* **4.2**);
- Nature of vibrations for endurance tests (*see* **6.4**);
- Type of test to be performed (*see* **6.1**);
- Category of testing for principal sub-assemblies as well as possible reduction of vibratory levels, depending on the mass of the equipment (*see* **6.4**);
- Verification of correct functioning to be carried out during tests.

2.2 *Optional*

- Parameters to be checked during and after testing;
- Piloting and inspection points;
- Possible endurance testing at actual resonance frequency in the case of special equipment (for example, aerial, tip or sabre, etc);
- Within the scope of the 'fixed-frequency sinusoidal vibrations' test, definition of particular excitation frequencies (*see* **6.1.2.2**);
- For the case of equipment sensitive to gravity (for example, gyro, orientation and particular specifications).

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3. Characteristics of Test Apparatus

3.1 The mounting shall allow the equipment to be vibrated along three main trirectangular axes.

3.2 The device shall be capable of setting in motion, in phase and along straight lines parallel to the axis under consideration, all the fixing points of the equipment.

When this condition is not satisfied, the transverse motion of the fixing points of the equipment being tested shall not exceed 25 percent of the movement over the axis under consideration. If the 25 percent tolerance cannot be adhered to (heavy or bulky equipment), attempts shall be made by appropriate methods to restrict this value to 100 percent. However, if this latter value cannot be adhered to for demonstrated technical reasons, it may be exceeded, provided the customer agrees. In all cases where the 25 percent tolerance is not adhered to, the values of the three acceleration components shall be noted in the test report.

3.3 When testing sinusoidal vibrations outside the resonance frequencies, the overall rate of harmonic distortion of the acceleration shall not, if possible, exceed 25 percent and the value shall be noted in the test report.

3.4 The characteristics of the sinusoidal values on the excitation axis are as follows:

- Speed of logarithmic sweep less than or, at most, equal to one octave per minute (equal in the absence of any particular specification);
- Tolerance on acceleration or displacement throughout the range ±15 percent.

3.5 The characteristics of wide band random vibrations on the excitation axis are as follows:

- Gaussian distribution of the amplitude eliminating peak values greater than three times the effective value;
- In a frequency band with a width of 1 000 $^{+50}_{-25}$ Hz and located anywhere in the specified frequency range, the true spectral density at the reference point shall not differ more than 3 dB from the specified spectral density;
- In addition, the effective acceleration throughout the band shall not differ by ±10 percent from the specified value.

3.6 When testing with recorded vibrations; it shall be ensured that the system for recording the vibrations of the table has a gain close to unity (tolerance +20 percent) in the band 5 to 2 000 Hz (to be measured before the equipment is mounted on the table).

The stray magnetic field above the exciter plate shall be so weak that it does not affect the correct functioning of the equipment under test. Where the stray field is likely to affect the equipment under test, the value of the field shall be measured and noted in the test report.

4. Installation of Equipment

4.1 *Mounting* — The equipment shall be fixed on the table in accordance with the instruction in the installation manual, using the points intended for fixing. Unless specified otherwise, the equipment shall be functioning.

4.2 *Precautions* — If the equipment is mounted in the aircraft in a given position, this position shall be taken into account when choosing the three trirectangular axes (*see* **2**). Otherwise, three arbitrary axes shall be chosen, but the definition of these axes shall be specified and indicated in the test report.

All connections (cables, wires, etc) shall impose stresses similar to those of standard aircraft mountings. If it is necessary when testing to use special connections, these shall not impose appreciable stresses.

5. Preliminary Verification of Correct Functioning — If no such verification has been carried out since the equipment reached the laboratory or since it was exposed to a different environment, or if it is considered appropriate by the person in charge of testing, correct functioning shall be verified under standard atmospheric conditions before commencing the actual tests.

6. Classification of Tests — Tests are classified according to the type of vibration applied (*see* **9**).

6.1 *Types of Tests*

6.1.1 *General case*

6.1.1.1 *Wide band random vibrations* — Test for equipment mounted in the aircraft. (Value of the spectral density in g^2/Hz defined within a given band.)

6.1.1.2 *Sinusoidal vibration with frequency sweep* — Standard test for all equipment which can be mounted in all types of aircraft.

6.1.1.3 *Narrow band random vibrations* — Test for all types of equipment intended to be mounted in the aircraft. (Values of acceleration gradient defined within a given band.)

6.1.1.4 *Sinusoidal resonance frequency vibrations* — (If required by the individual specification) — Testing of sinusoidal vibrations at each of the critical frequencies of the equipment (with a maximum of four test frequencies).

6.1.2 *Special cases*

6.1.2.1 *Recorded vibrations* (*E*) — Testing of equipment intended for a particular type of aircraft and for a specific position.

6.1.2.2 *Fixed frequency sinusoidal vibrations* (*F*) — Application of fixed-frequency sinusoidal vibrations to equipment mounted on a particular aerodyne exhibiting well-defined excitation frequencies (for example, ' rotodyne ').

6.2 *Classification of Equipment* — Equipment is classified according to the categories of aircraft for which it is intended.

6.2.1 Helicopters — Sub-categories
Piston-engined
Turbine-engined

6.2.2 Turbine-engined aircraft — Sub-categories
Subsonic
Supersonic

6.2.3 Piston-engined aircraft — Sub-categories
Multi-engined
Single-engined

6.2.4 Equipment for all aircraft

6.3 *Severity* — The severity of testing depends on three utilization characteristics:

- The category of the aircraft;
- The position of the equipment in the aircraft;
- Where necessary, the mass of the equipment.

6.3.1 The category of the aircraft and the position of the equipment in the aircraft make it possible to define the vibratory environment which may be encountered by the equipment.

6.3.2 As regards the mass, the placing of a load on the structure generally produces an increase in its mechanical damping. Thus, in an equivalent vibratory environment of the mass of the equipment is greater than 30 kg, a lower severity may be accepted, the greater the mass of the equipment. However, this possibility is applicable only to relatively heavy equipment.

6.3.3 The degree of severity shall be specified by the client in the form of a code determined by the guide to choice, depending on the performance characteristics. (*See* **6.4** and Tables 1 and 2.)

6.4 *Guide to Choice* — *See* Tables 1 and 2.

6.4.1 *Standard levels* (*see* Table 1) — These levels, equivalent to those in specification RTCA : Radio Technical Commission for Aeronautics (United States) DO 138, are generally applicable to civil aircraft.

6.4.2 *Severe levels* (*see* Table 2) — These levels, derived from those in specification MILSTD 810 B, are applicable in principle to military aircraft, but may also be used for civil aircraft, by special request.

6.4.2.1 *Mass*

If Mz 30 kg, lower severity.

This 30 kg limit, a recommended value, may be changed by the client.

6.4.3 *Position of the equipment in the aircraft* — Equipment including an integrated damper is covered by **6.4.3.1** and **6.4.3.2**. Such equipment shall not be separated from the damper during testing.

6.4.3.1 Direct mounting on to the structure in the front of the fuselage.

6.4.3.2 Direct mounting on to the structure in other parts of the fuselage.

6.4.3.3 Indirect mounting on frames, panels or cabinets themselves linked to the structure without damping systems.

6.4.3.4 Special case of equipment intended to be mounted on an instrument panel or any other support linked to the structure by a damping system.

6.4.3.5 Equipment mounted directly on to an engine.

6.4.3.6 Equipment mounted in the area of the engine.

6.4.3.7 Equipment mounted on the wings.

6.4.3.8 Equipment mounted on stabilizers and wheel housings.

7. Test Methods — Tests are carried out on each axis in succession. The equipment is mounted on a table, in accordance with the installation guide (with a damping device if the guide provides for this). Operation is at maximum speed.

7.1 *Stage 1* — Initial resonance search (Table 3, curve B)

— Sinusoidal vibrations (frequency sweep at logarithmic speed).

— Level.

— 5 to 40 Hz..
— 40 to 500 Hz..
or
— 40 to 2 000 Hz..

} The peak to peak amplitude 0·3 mm; (according to category) 2g.

When these levels are greater than those set out for the sinusoidal endurance of the category of equipment, the lowest value shall be retained, that is, the endurance level.

— Duration : 1 cycle (one movement to-and-fro between the minimum and the maximum frequencies).

— The suspension shall not resonate at the resonance frequencies.

— All of excess tensions shall be noted as well as those resonance frequencies at which the suspension for the equipment under test resonates.

7.2 *Stage 2—Endurance Test* — During this stage, correct functioning shall be verified for each axis, with the equipment operating at the maximum speed.

As above (*see* **7.1**), the suspension shall not resonate. This duration test appears in six different forms according to the type of vibration (to be specified by the client).

7.2.1 *Wide band random vibrations*

7.2.1.1 Values in accordance with Tables 10 and 11 and Fig. 1 and 2 defined by the code of severity taken from Tables 1 and 2.

7.2.1.2 *Duration*

Code A to Z : 1 h per axis.

Code ZA to ZZ : 2 h 3o min per axis.

However, the specified duration does not include the time required for the spectrum to form when the spectrum is not obtained automatically. In the latter case, the overall duration of the preliminary analysis and the formation of the spectrum shall be limited so as not to put too great a strain on the equipment before the actual test.

The time for adjusting random vibrations shall, therefore, be limited as follows, depending on the level at which it is carried out:

a) Less than 25% of the specified spectral density : no limit;
b) From 25 to 50% of the specified level : duration limited to 1·5 times that of the endurance test;
c) From 50 to 100% of the specified level : duration limited to 10% of that of endurance level.

7.2.2 *Sinusoidal vibrations with sweep*

7.2.2.1 Values in accordance with Tables 4 to 9 defined by the code of severity taken from Tables 1 and 2.

7.2.2.2 Duration outside the specific case defined in **7.2.6**.

7.2.3 *Narrow band random vibrations* — When this method is used, the procedure, levels and duration shall be subject to preliminary agreement between the client and the equipment manufacturer.

7.2.4 *Sinusoidal resonance frequency vibrations*

7.2.4.1 This type of test shall be carried out at the 'critical' frequencies detected when investigating resonances.

7.2.4.2 The frequencies at which the most severe resonances appear, up to a maximum of four per axis, shall be tested for 30 min each.

7.2.4.3 The test frequency shall be so adjusted that the resonance is always excited at its maximum excess tension.

7.2.4.4 The levels to be applied are those specified for sinusoidal testing freguency sweep (acceleration on the ordinate corresponding to the frequency on the abscissa).

7.2.4.5 The 'critical' frequencies are those at which a change in the performance or behaviour of the equipment may be noted.

7.2.5 *Recorded vibrations* — Where this method is used, the procedure, levels and duration shall be subject of a previous agreement between the client, the aircraft manufacturer and the equipment manufacturer.

7.2.6 *Fixed-frequency sinusoidal vibrations* — The test device shall be capable of following any possible drifts in the resonance frequency and the coefficient of excess tension during the test. The test report shall indicate the values of the resonance frequency drift, of the coefficient of excess tension and the drift in this coefficient.

7.2.6.1 *Values*

- — Tables 4 and 9 and the guide to choice (Tables 1 and 2);
- — The applicable value is the ordinate corresponding to the frequency under consideration, read off on the abscissa.

TABLE 1 GUIDE TO CHOICE OF SEVERITIES APPLICABLE TO DURATION TESTS — STANDARD LEVELS

(*Clauses* 6.3.3, 6.4, 6.4.1, 7.2.1.1, 7.2.2.1 *and* 7.2.6.1)

Category of Aircraft		Position of Equipment						
		Equipment Mounted Directly on to the Fuselage	Equipment Installed on Suspended Rack or Instrument Panel*	Equipment Installed on Non-suspended Rack	Equipment Installed in Engine Zone	Equipment Mounted Directly on to an Engine	Equipment Installed on the Wings	Equipment Installed in Stabilizers and Wheel Housings
Helicopters	Piston-engined	N	P	N	U	U	V	V
	Turbine-engined	N	P	N	W	W	V	V
Turbine-engined aircraft	Subsonic	J	K	O	R	W	R	R
	Supersonic	J	K	O	R	W	R	R
Piston-engined aircraft	Multi-engined over 6 000 kg	L	B	M	T	U	T	T
	Multi-engined less than 6 000 kg	M	S	M	L	L	L	L
	Single-engined less than 6 000 kg	M	S	M	M	L	M	M

Note — Level R — Excluding all equipment mounted directly on to a structural component affected by the jet or jets.

*Instrument panel : suspended or not.

7.2.6.2 *Duration*

— 20 mm per axis on each selected frequency.

7.3 *Stage 3 — Final Resonance Search* — Repeat of stage 1.

8. Exploratory Tests (Table 3, Curve A) — In the case of finalizing tests, the method below may be used (if it is additionally specified before the procedure described in 7).

The equipment is fixed on the table without anti-vibration supports, if possible with the casing removed, and functioning.

If the equipment has no anti-vibration supports, move on directly to stage 1 (*see* 7.1).

The test consists in discovering the resonance frequencies:

—sinusoidal vibrations (frequency sweep at logarithmic speed of 1 octave per minute):

— 5 to 40 Hz
— 40 to 500 Hz
or
— 40 to 2 000 Hz
— number of cycles : 2

According to category (40 to 500 Hz or 40 to 2 000 Hz; number of cycles : 2).

Amplitudes and acceleration shall form the subject of a preliminary agreement between the client and the equipment manufacturer; otherwise, apply the levels in Table 2.

A cycle consists of a to-and-fro movement between the minimum and the maximum frequency.

9. Final Verification of Correct Functioning

Verification of correct functioning at maximum speed.

Inspection after endurance to detect deterioration.

TABLE 2 GUIDE TO CHOICE OF SEVERITIES APPLICABLE TO DURATION TESTS — SEVERE LEVELS

(*Clauses* 6.3 3, 6.4, 6.4.2, 7.2.1.1, 7.2.2.1, 7.2.6.1 *and* 8)

Category of Aircraft	Mass of Equipment	Position of Equipment							
		Fuselage				In the Area of the Engines (Area C*)	Fixed Directly to an Engine	In the Wing (Area D*)	In the Stabilisers or the Wheel Housing (Area E*)
		Fixed rigidly to the front part (area A*)	Fixed rigidly to the rear part (area B*)	Fixed to instrument panel or suspended rack	Fixed to non-suspended rack				
Aircraft with engine at rear of fuselage	<30 kg	ZE	ZF	ZA	ZE	ZK	ZL	ZE	ZF
	>30 kg	ZD	ZE	ZA	ZD	ZF	ZL	ZD	ZE
Aircraft with engine at front or in wings	<30 kg	ZE	ZF	ZA	ZE	ZK	ZL	ZF	ZF
	>30 kg	ZD	ZE	ZA	ZD	ZF	ZL	ZE	ZE
Helicopters	<30 kg	ZB	ZB	ZC	ZB	ZU	ZU	ZM	ZM
	>30 kg	ZC	ZC	ZC	ZC	ZU	ZU	ZC	ZC
All aircraft	<30 kg	ZG	ZH	ZP	ZG	ZQ	ZQ	ZR	ZR
	>30 kg	ZG	ZG	ZP	ZG	ZQ	ZQ	ZN	ZN

*The areas for dynamic conditions A to E are specified for usual cases in Fig. 4 and 5.

TABLE 3 LEVELS FOR INVESTIGATION OF RESONANCE FREQUENCIES AND EXPLORATION TESTING

(*Clauses* 7.1 *and* 8)

CURVE	TRANSITIONAL FREQUENCIES						
	5 Hz	Hz	Hz	Hz	Hz	Hz	
A	$a = 0.15$		40	$\gamma = 1$		2000	▨
B	$a = 0.3$		40	$\gamma = 2$		2000	▨

γ = amplitude of acceleration in multiples of g
a = simple amplitude of motion in millimetres
v = speed in millimetres per second

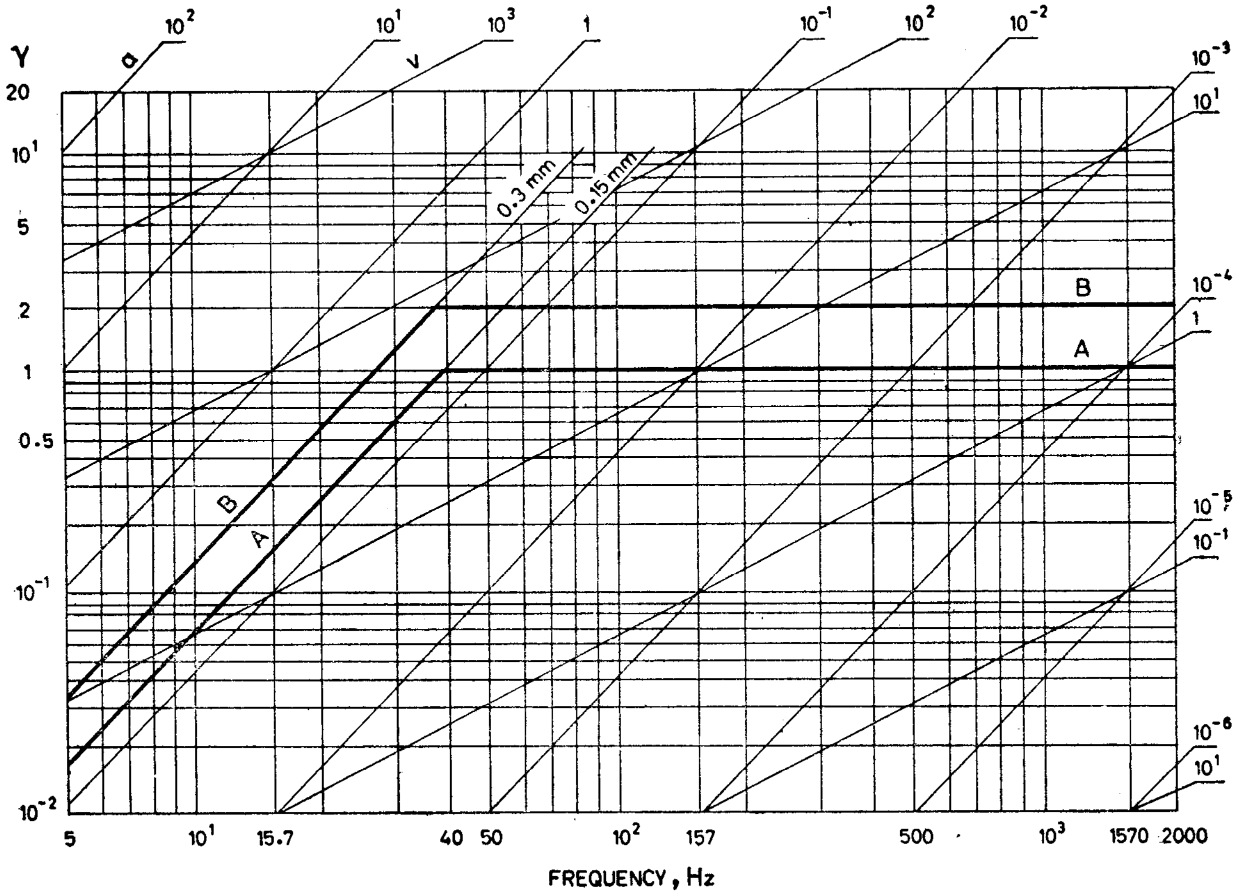


TABLE 4 SINUSOIDAL VIBRATIONS — STANDARD LEVELS

(*Clauses* 7.2.2.1 *and* 7.2.6.1)

CATEGORY : HELICOPTERS

SEVERITY	TRANSITIONAL LEVELS AND FREQUENCIES										
N	$a = 1.25$	17 Hz	$\gamma = 1.5$	55 Hz	$\gamma = 1$	2000 Hz					
P	$a = 1.25$	17 Hz	$\gamma = 1.5$	55 Hz	$\gamma = 0.25$	2000 Hz					
U	$a = 1.25$	62 Hz	$\gamma = 20$	150 Hz							
V	$a = 5$	10 Hz	$\gamma = 2$	200 Hz							
W	$a = 1.25$	17 Hz	$\gamma = 1.5$	29 Hz	$a = 0.45$	74 Hz	$\gamma = 10$	260 Hz	$a = 0.375$	370 Hz	$\gamma = 20$

γ = acceleration in multiples of g

a = simple amplitude of motion in millimetres

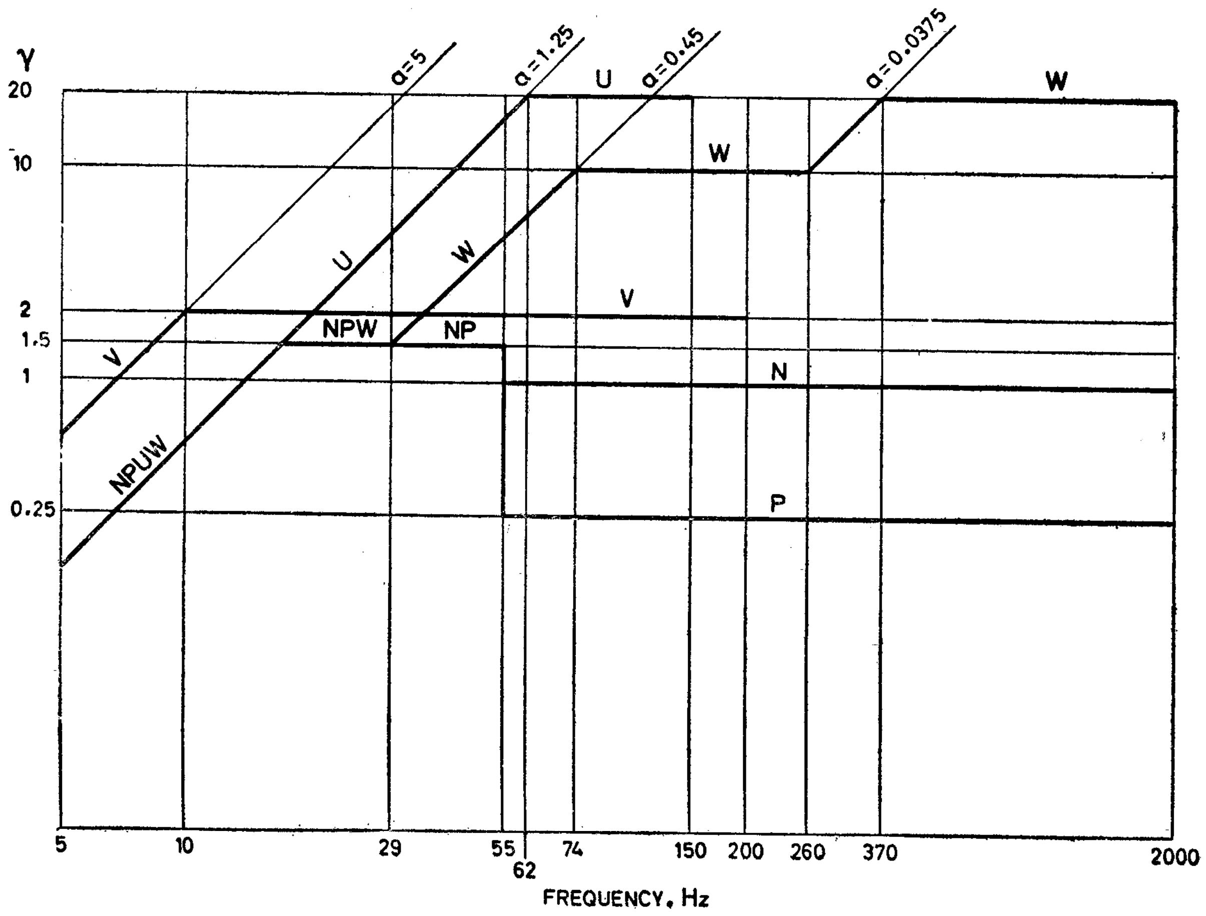


TABLE 5 SINUSOIDAL VIBRATIONS – STANDARD LEVELS

(*Clause* 7.2.2.1)

CATEGORY : TURBINE-ENGINED AIRCRAFT

SEVERITY	TRANSITIONAL LEVELS AND FREQUENCIES											
K	a = 0.125	22 Hz	γ = 0.25	2000 Hz								
O	a = 0.125	55 Hz	γ = 0.50	2000 Hz								
J	a = 0.25	56 Hz	γ = 3	2000 Hz								
R	a = 0.375	58 Hz	γ = 5	350 Hz	a = 0.01	500 Hz	γ = 10	2000 Hz				
W	a = 1.25	17 Hz	γ = 1.5	29 Hz	a = 0.45	74 Hz	γ = 10	260 Hz	a = 0.0375	370 Hz	γ = 20	2000 Hz

γ = acceleration in multiples of g
a = simple amplitude of motion in millimetres

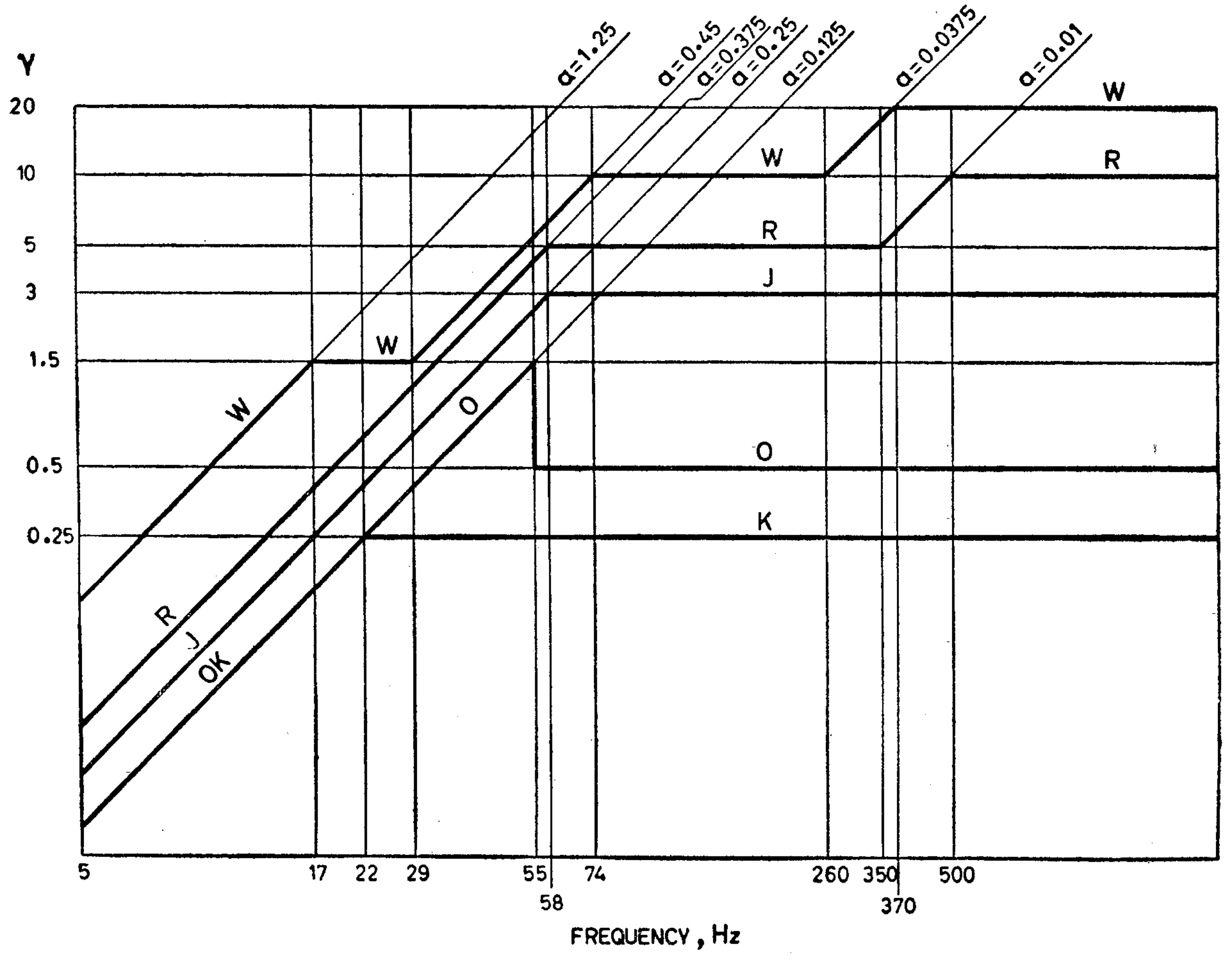


TABLE 6 SINUSOIDAL VIBRATIONS — STANDARD LEVELS

(*Clause* 7.2.2.1)

CATEGORY: PISTON-ENGINED AIRCRAFT

SEVERITY	TRANSITIONAL LEVELS AND FREQUENCIES				
L	a=0.25	55 Hz			
M	a=0.125	55 Hz	γ = 1.5	100 Hz	
T	a=0.45	74 Hz	γ = 10	500 Hz	
U	a=1.25	62 Hz	γ = 20	150 Hz	
S	a=0.125	32 Hz	γ = 0.5	100 Hz	

γ = acceleration in multiples of g
a = simple amplitude of motion in millimetres

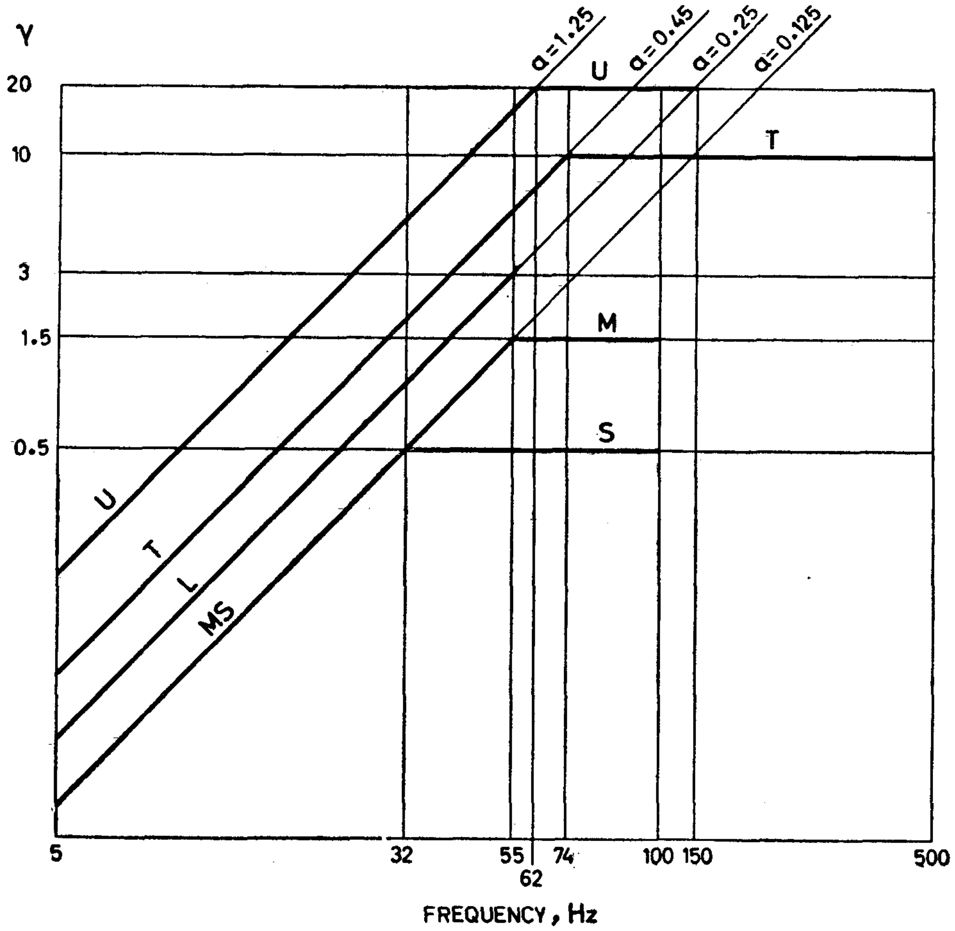


TABLE 7 SINUSOIDAL VIBRATIONS — SEVERE LEVELS

(*Clause* 7.2.2.1)

SEVERITY	TRANSITIONAL LEVELS AND FREQUENCIES											
ZA	a = 1.25	17 Hz	γ = 1.5	29 Hz	a = 0.45	33 Hz	γ = 2	500 Hz				
ZD	a = 1.25	17 Hz	γ = 1.5	29 Hz	a = 0.45	33 Hz	γ = 2	2000 Hz				
ZE	a = 1.25	17 Hz	γ = 1.5	29 Hz	a = 0.45	52 Hz	γ = 5	2000 Hz				
ZF	a = 1.25	17 Hz	γ = 1.5	29 Hz	a = 0.45	74 Hz	γ = 10	2000 Hz				
ZK	a = 1.25	17 Hz	γ = 1.5	29 Hz	a = 0.45	74 Hz	γ = 10	260 Hz	a = 0.00375	314 Hz	γ = 15	2000 Hz
ZL	a = 1.25	17 Hz	γ = 1.5	29 Hz	a = 0.45	74 Hz	γ = 10	260 Hz	a = 0.00375	370 Hz	γ = 20	2000 Hz

γ = acceleration in multiples of g
a = simple amplitude of motion in millimetres
ZL = identical to level *W* in Table 4

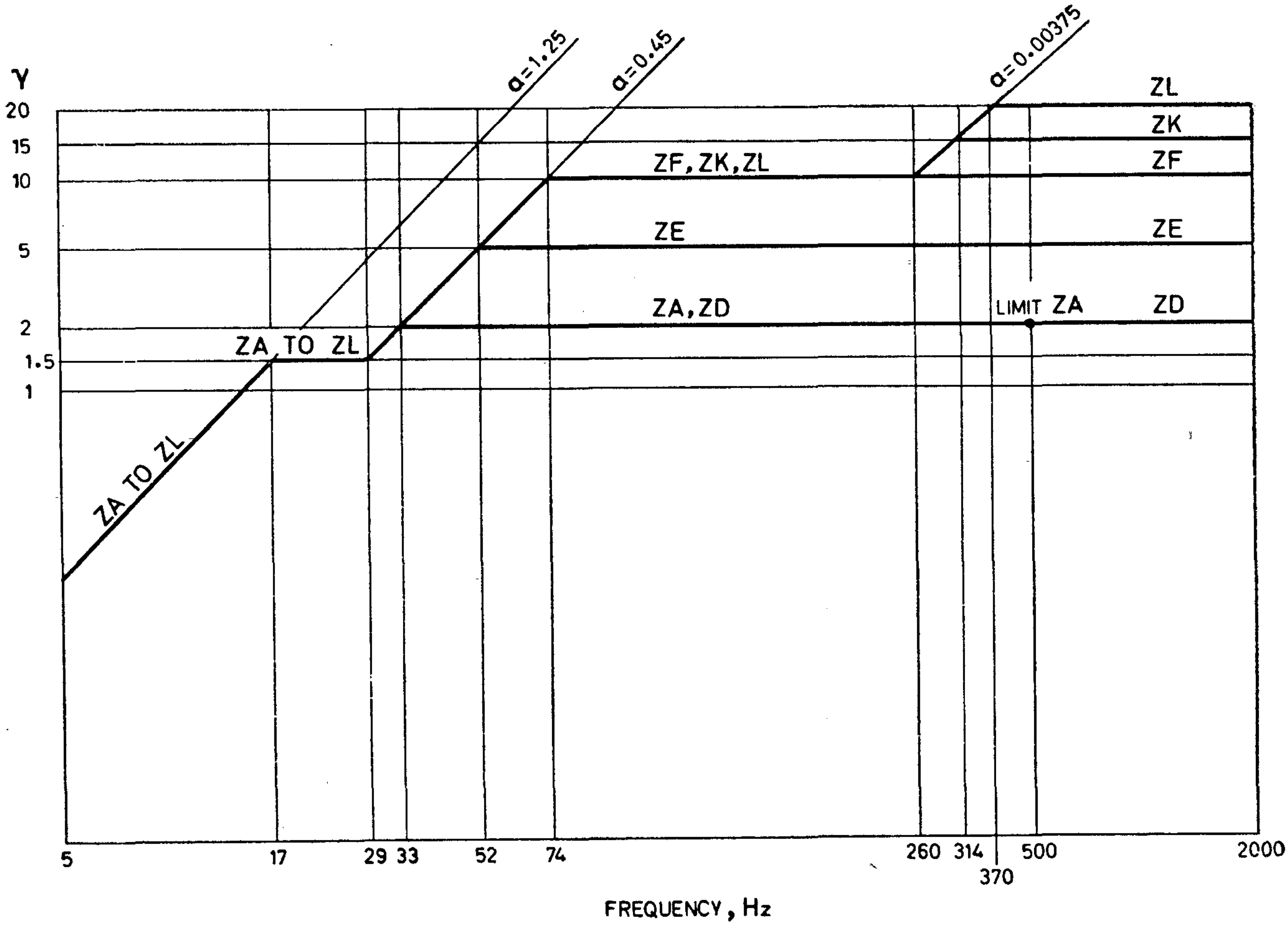


TABLE 8 SINUSOIDAL VIBRATIONS — SEVERE LEVELS

(*Clause* 7.2.2.1)

CATEGORY : HELICOPTERS

SEVERITY	TRANSITIONAL LEVELS AND FREQUENCIES								
ZB	a = 1.25	18 Hz	γ = 2	33 Hz	a = 0.45	53 Hz	γ = 5	500 Hz	
ZC	a = 1.5	18 Hz	γ = 2	500 Hz					
ZM	a = 5	10 Hz	γ = 2	33 Hz	a = 0.45	53 Hz	γ = 5	500 Hz	
ZU	a = 1.5	58 Hz	γ = 20	500 Hz					

γ = acceleration in multiples of g
a = simple amplitude of motion in millimetres

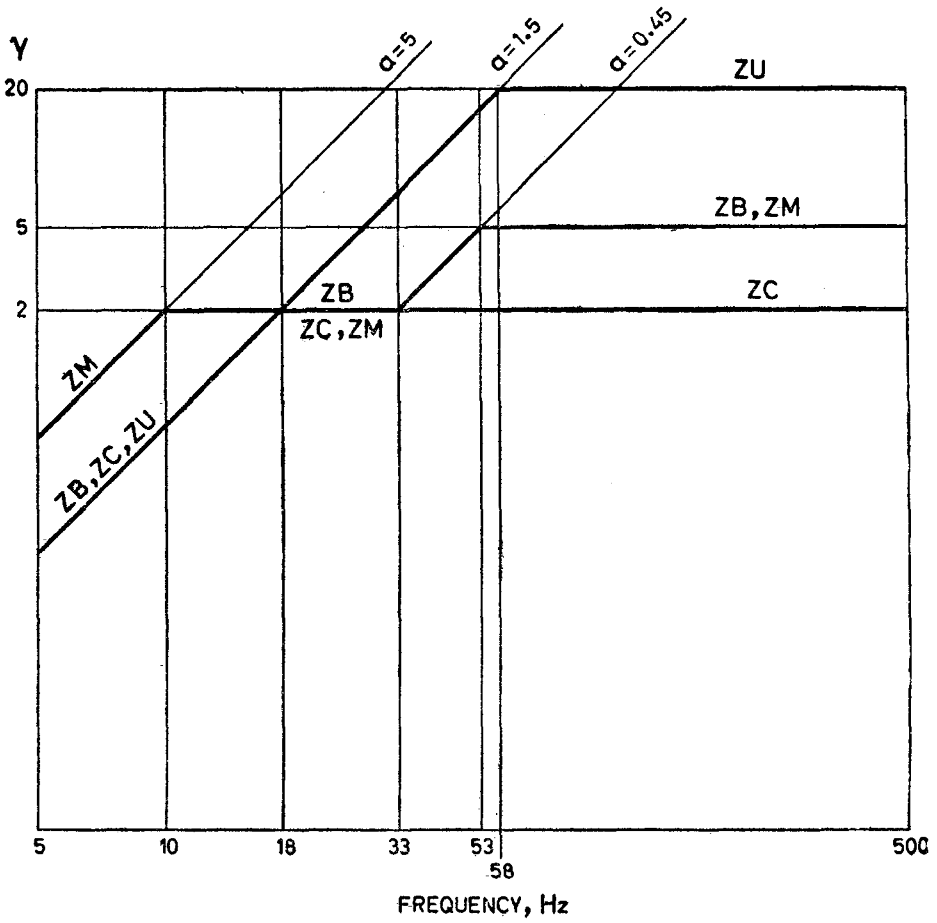


TABLE 9 SINUSOIDAL VIBRATIONS — SEVERE LEVELS

(*Clauses* 7.2.2.1 *and* 7.2.6.1)

CATEGORY : ALL AIRCRAFTS

SEVERITY	TRANSITIONAL LEVELS AND FREQUENCIES								
ZP	a = 1.5	18 Hz	γ = 2	2000 Hz					
ZG	a = 1.5	18 Hz	γ = 2	33 Hz	a = 0.45	53 Hz	γ = 5	2000 Hz	
ZN	a = 5	10 Hz	γ = 2	33 Hz	a = 0.45	53 Hz	γ = 5	2000 Hz	
ZQ	a = 1.5	58 Hz	γ = 20	2000 Hz					
ZR	a = 5	10 Hz	γ = 2	33 Hz	a = 0.45	75 Hz	γ = 10	2000 Hz	
ZH	a = 1.5	18 Hz	γ = 2	33 Hz	a = 0.45	75 Hz	γ = 10	2000 Hz	

γ = acceleration in multiples of g
a = simple amplitude of motion in millimetres

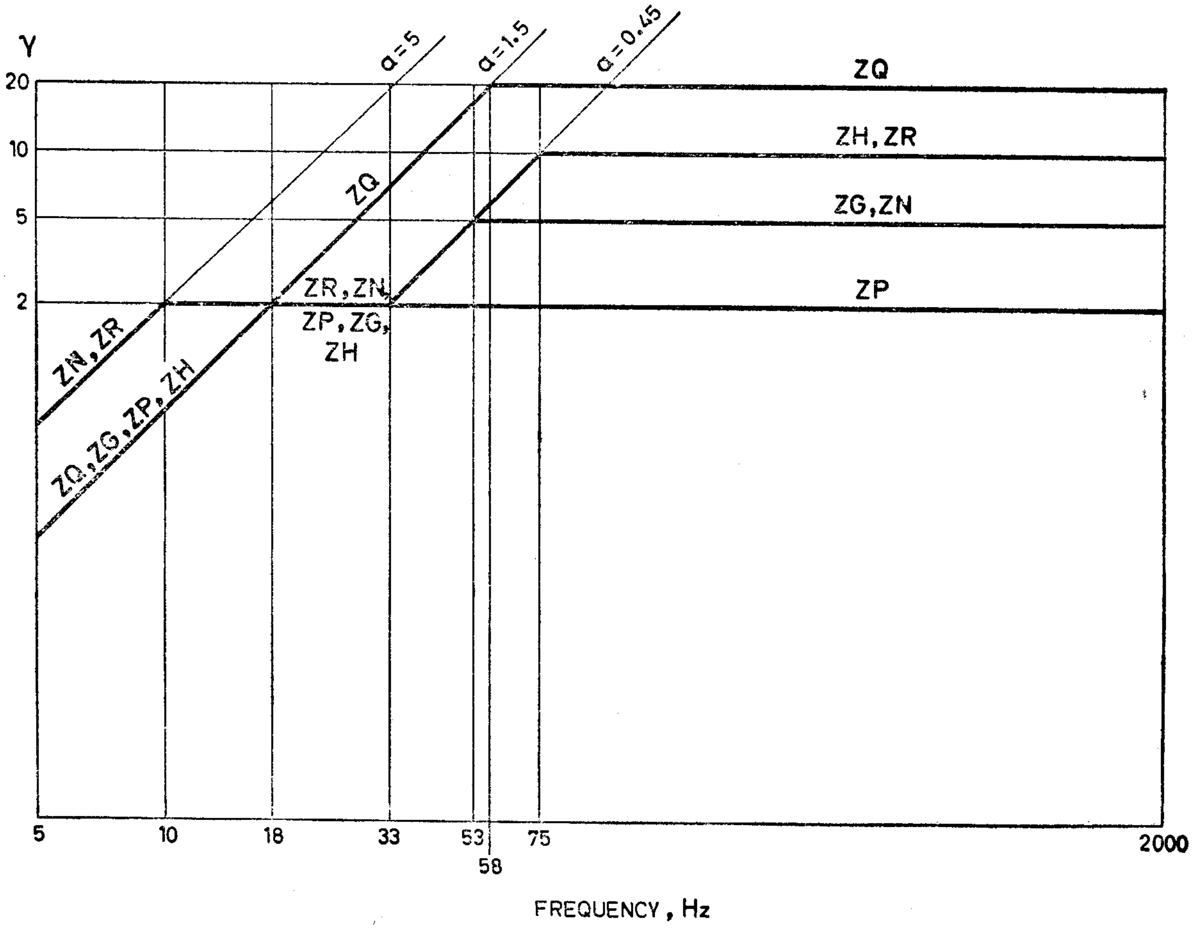


TABLE 10 WIDE BAND RANDOM VIBRATION TESTS — STANDARD LEVELS

(*Clause* 7.2.1.1)

Category	Severity According to Table 1	Frequency Range	Maximum Spectral Power Density g^2/Hz	Form of Spectrum (*see* Fig. 1)	Total Effective Acceleration g_{eff}	Comments
Helicopters	N P U V W					Type of test under study for helicopters
Turbine-engined aircraft	J	10 to 2 000 Hz	0·02	S2	3·85	Under study
	K		0·000 1	S0	0·27	
	O					
	R		0·000 5	S1	0·61	
	W		0·08	S3	8·90	
Piston-engined aircraft	L M T U S					Type of test under study for piston-engined aircraft

TABLE 11 — WIDE BAND RANDOM VIBRATION TESTS — SEVERE LEVELS

(*Clause* 7.2.1.1)

Category	Severity According to Table 2	Frequency Range	Maximum Spectral Power Density g^2/Hz	Form of Spectrum (*see* Fig. 2)	Total Effective Acceleration g_{eff}	Comments
Aeroplanes	ZA	10 to 2 000	0·01	S5	2·73	
	ZD		0·05	S6	6·10	
	ZE		0·20	S7	12·20	
	ZF*		0·50	S8	19·20	
	ZK*		0·50	S8	19·20	
	ZL*					
Helicopters	ZB ZC ZM ZP ZU*	10 to 500				Type of test under study for helicopters
All aircraft	ZC	10 to 2 000	0·05	S6	6·10	
	ZH*		0·20	S7	12·20	
	ZN		0·05	S6	6·10	
	ZP		0·50	S8	19·20	
	ZQ*		0·20	S7	12·20	
	ZR*					

Note — It is possible to reduce the maximum level for the spectral power density to 50% of the value indicated in the table, provided that there is an increase in the duration according to the curve in Fig. 3.

*Categories : ZF, ZH, ZK, ZL, ZU, ZQ, ZR.

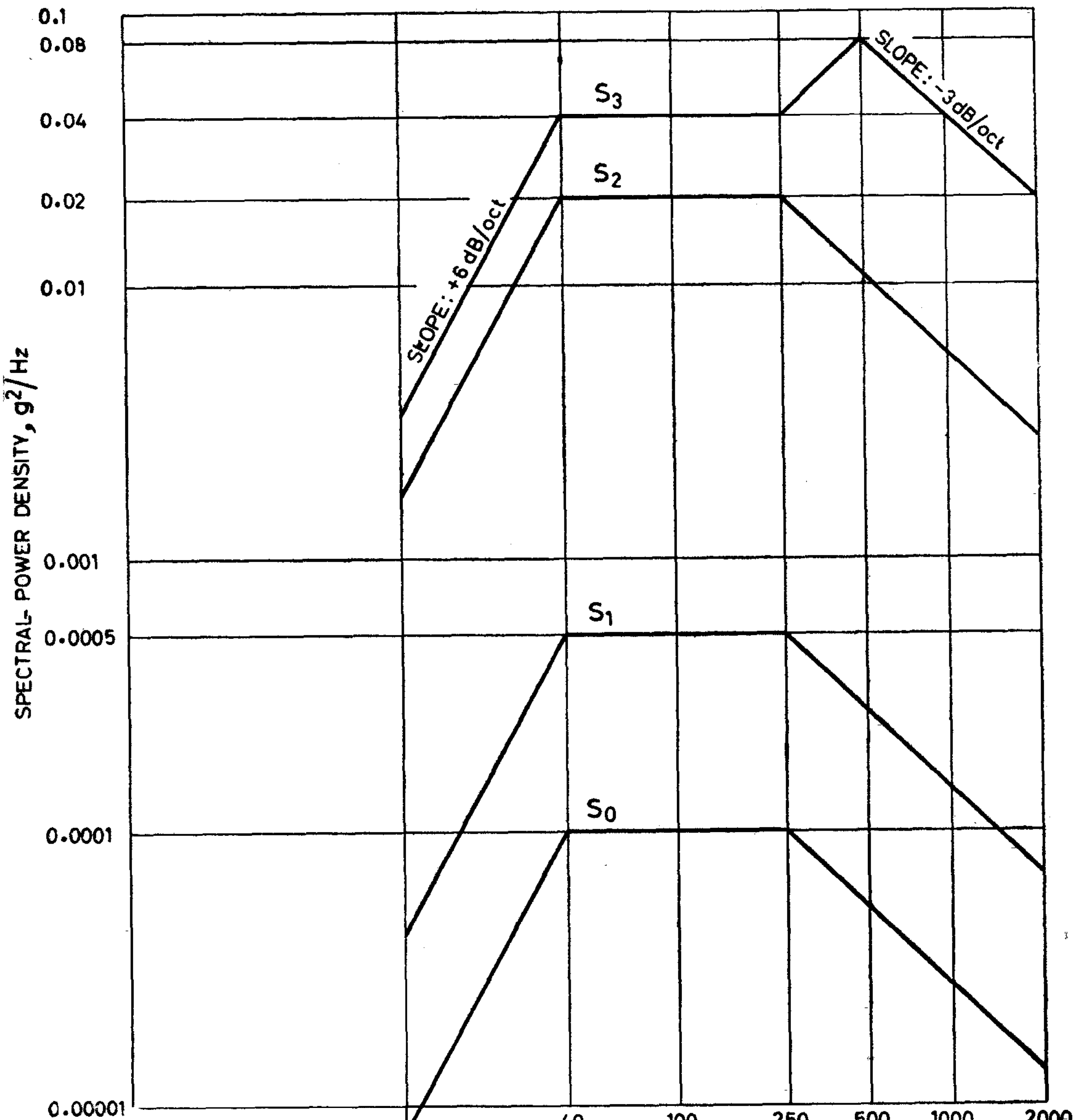


FIG. 1 WIDE BAND RANDOM VIBRATION TESTS — STANDARD LEVELS

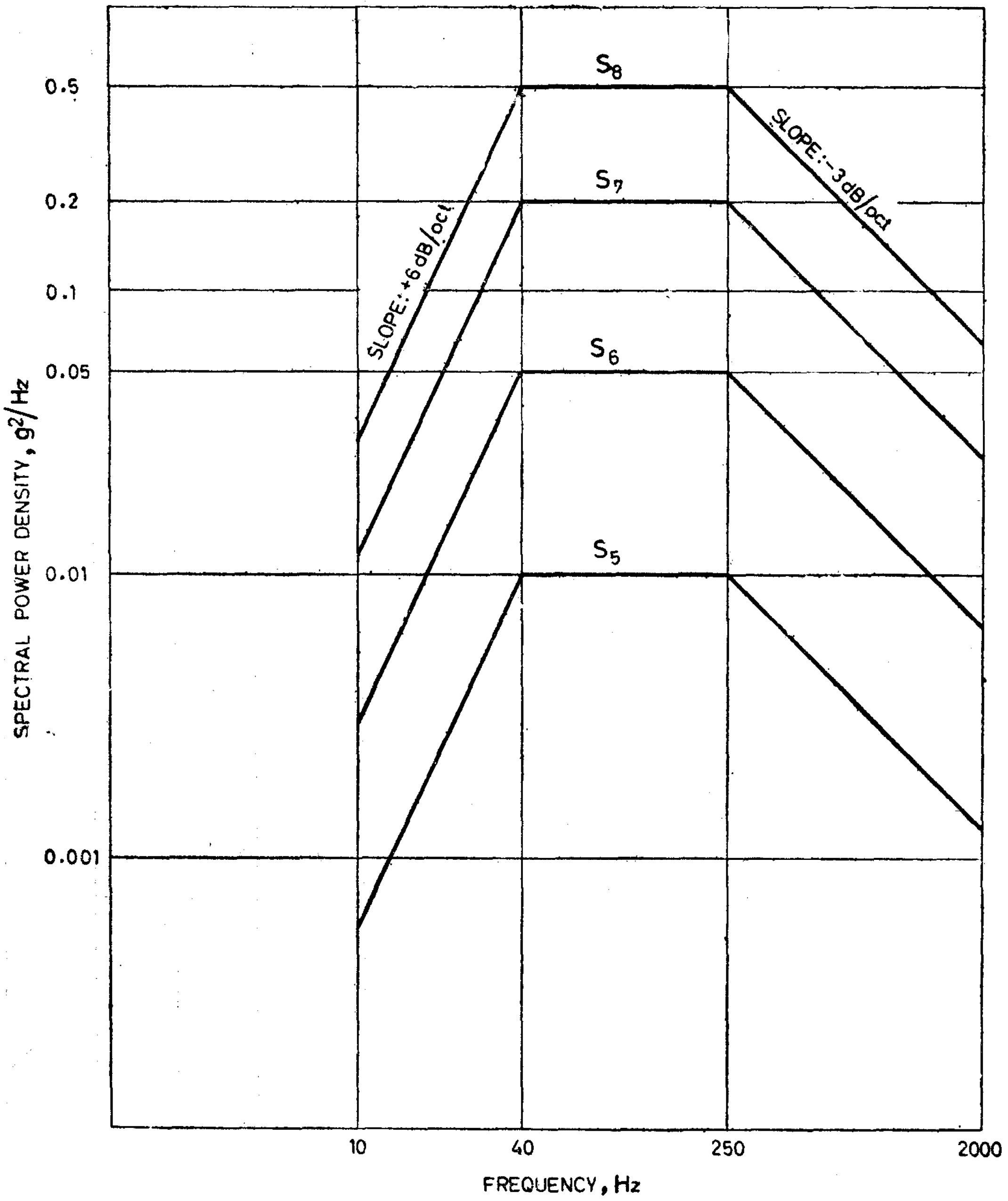
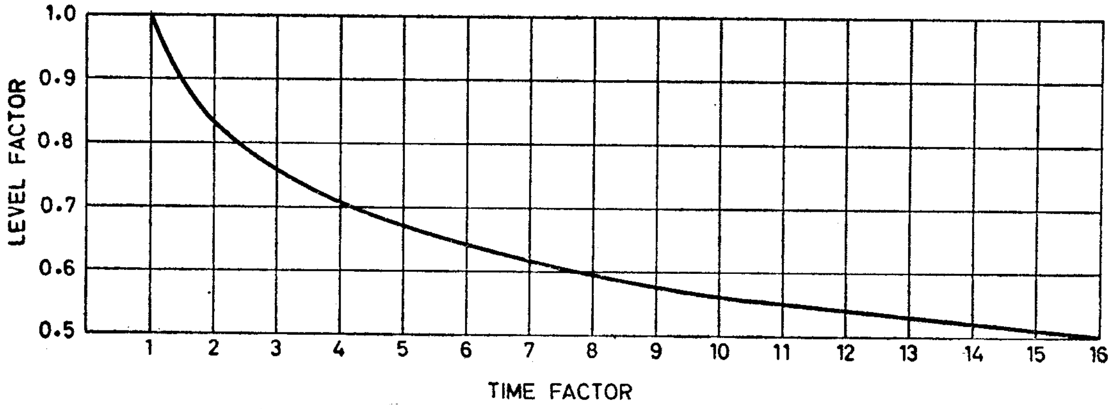


FIG. 2 WIDE BAND RANDOM VIBRATION TESTS — SEVERE LEVELS



$$t_2 = t_1 \times \left(\frac{G_1}{G_2}\right)^{2.5}$$

where

t_1 is the duration of a test with a spectral power density G_1;
t_2 is the duration of an equivalent test with a spectral power density G_2.

Note — The exponent 2·5 may be replaced by a different one (n) if so specified by the client.

FIG. 3 WIDE BAND RANDOM VIBRATIONS — RELATIONSHIP BETWEEN THE DURATION AND THE LEVEL OF TESTING
(Applied only to spectra S_7, S_8, S_9, S_{12})

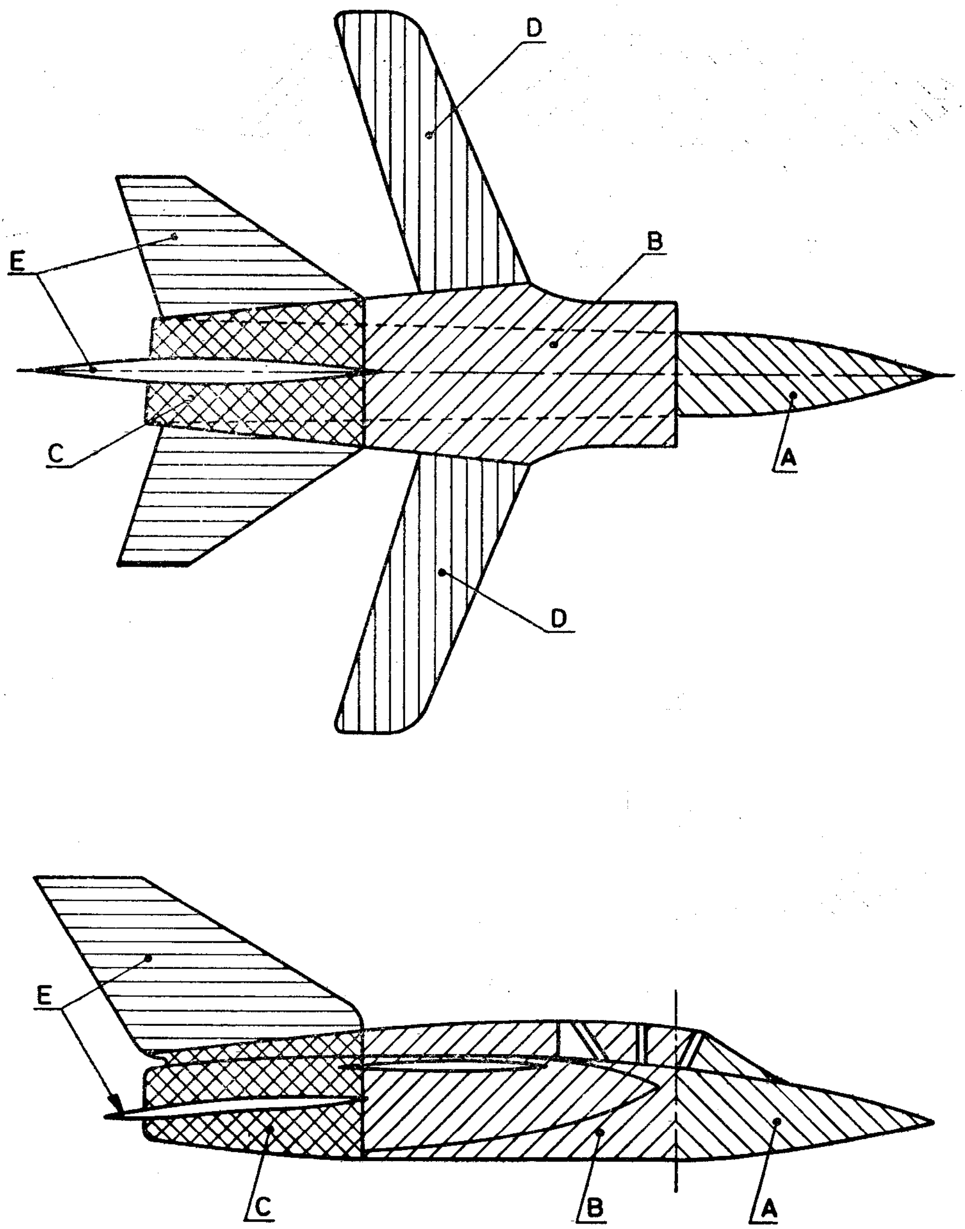


FIG. 4 AREAS OF DYNAMIC CONDITIONS — AIRCRAFT WITH ENGINE AT REAR OF FUSELAGE

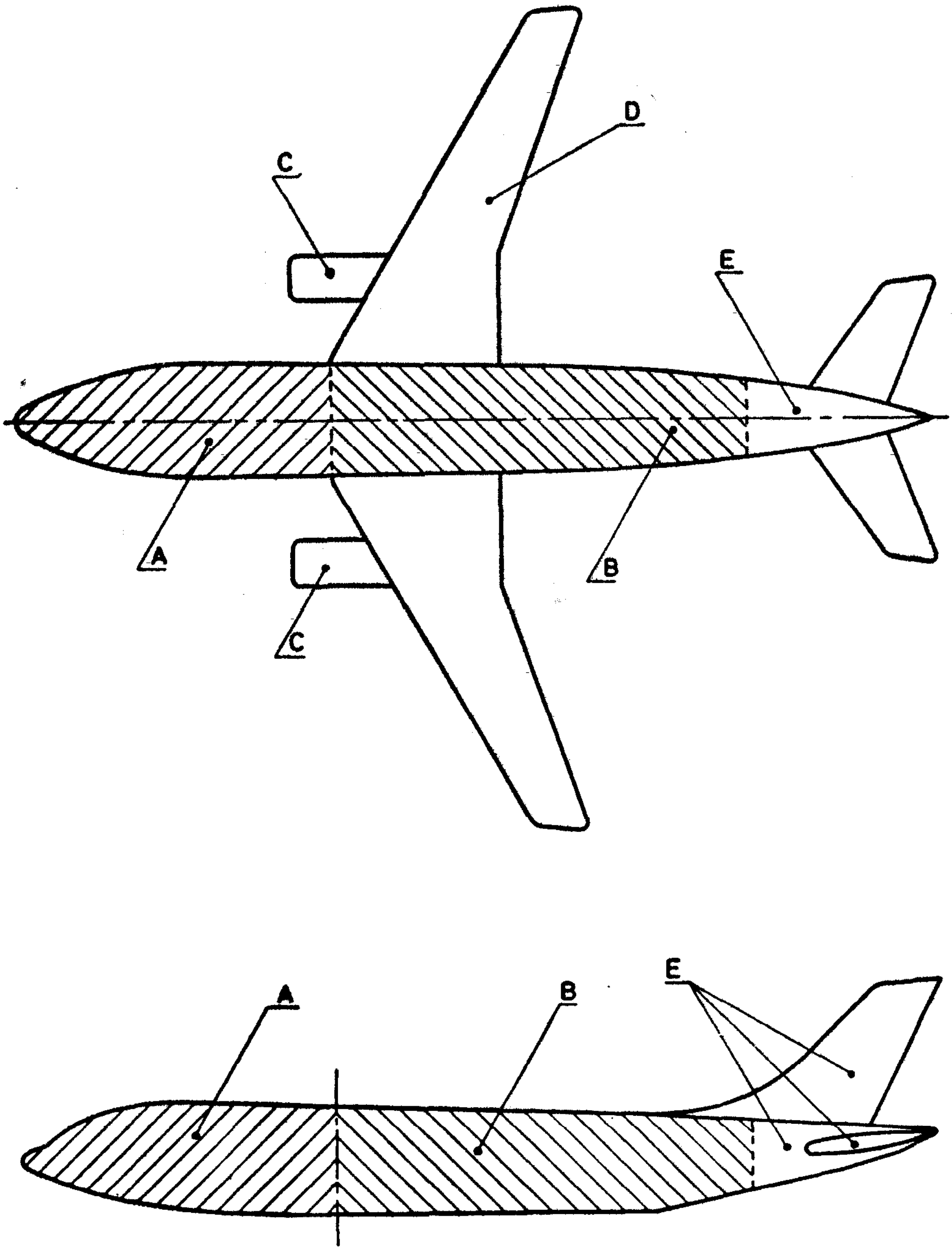


FIG. 5 AREAS WITH DYNAMIC CONDITIONS — AIRCRAFT WITH ENGINES IN THE WINGS

EXPLANATORY NOTE

This standard is one of the series of standards relating to the environmental and operating conditions for aircraft equipment. The scope and applicability of these standards is given in IS : 8252 (Part I)-1976 ' Environmental tests for aircraft equipment: Part I General '.

This standard is based on ISO/DIS 2668 Environmental tests for aircraft equipment — Part 3.1; Mechanical vibration, issued by the International Organization for Standardization (ISO).

The other Indian Standards published in the series are:

IS : 8252 (Part II)-1980 Environmental tests for aircraft equipment:
Part II Temperature, pressure and humidity

IS : 8252 (Part III)-1978 Environmental tests for aircraft equipment:
Part III Humidity (24 hour cycle)

IS : 8252 (Part IV)-1978 Environmental tests for aircraft equipment:
Part IV Ice formation

IS : 8252 (Part VI)-1976 Environmental tests for aircraft equipment:
Part VI Water proofness

IS : 8252 (Part VIII)-1979 Environmental tests for aircraft equipment:
Part VIII Change of temperature

IS : 8252 (Part X)-1979 Environmental tests for aircraft equipment:
Part X Saltmist

IS : 8252 (Part XI)-1976 Environmental tests for aircraft equipment:
Part XI Differential pressure

IS : 8252 (Part XVI)-1979 Environmental tests for aircraft equipment:
Part XVI Shock

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